

America, and we believe the Filices are also to be included.

We are pleased to see that at the conclusion of the work it is announced that an introductory volume will be given containing an account of the physical features of the country and a series of maps. No specially faunistic work should be issued in these days without a map, and in that map moreover all the localities mentioned in the letterpress should be inserted. Furthermore care should be taken that the names of the places should be spelt alike in the letterpress and in the map—a point which in several instances that have come before us, has not been sufficiently attended to.

We are, however, fully aware that in the present case our authors are well acquainted with the value of geography—one of the two "*faces Zoologiae*," as the late Prince Bonaparte called it, and we do not fear that they will even spell their names of places incorrectly. And on the whole it may be fairly said that the "*Biologia Centrali-Americana*," if carried, and we doubt not it will be carried, to its promised extent, favoured as it is by the co-operation of some of the most accomplished naturalists of the day, will not only remain a lasting testimony to the learning and munificence of its editors, but will also equal in completeness and finish any geographical work on natural history ever published.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*]

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

Visualised Numerals

It may interest those who have read my memoir in NATURE, vol. xxi. p. 252, on visualised numerals, to learn some of the principal results obtained thus far through its publication. I have received several new diagrams more or less similar to those already published, so that I have now about thirty of them in all. My new contributors are of the same classes as before. There is only one high mathematician among them; the remainder are pursuers of science, authors of various degrees of reputation, persons engaged in tuition, students at Oxford and Cambridge, some other adults, and one schoolboy. If my collection becomes still further increased, I have grounds for belief that I shall be able to classify the cases, and to extract more meaning out of them than has hitherto been feasible.

It has been a satisfaction to me to receive emphatic acknowledgment of its correctness from the author of the curious shaded diagram (Fig. 5) in the memoir. The sketch sent to me was drawn with evident painstaking, but it was rubbed and faint; the engraver, however, succeeded in justly interpreting it, and supplying its defects of tone. Fig. 4 is unfortunate, and I am to blame. I stated in the accompanying text that I had compiled it from a large diagram, much as a map-maker would compile a small map from an elaborate itinerary. However, my map proves to be a failure, so I withdraw it. The other diagrams were almost exact reductions of plain drawings; their truth has been acknowledged in one group of cases, and I have no grounds for doubt as to the remainder. FRANCIS GALTON

42, Rutland Gate, London

A Psychological Aspect of the Vortex-Atom Theory

It is a very generally accepted fact that the phenomena of thought are at least connected with a physical basis, however difficult it may be at present to trace the connection. The dependence, however, of mental attributes and sensations upon

brain-structure, is too notorious a fact to admit of doubt by competent judges. This view is illustrated well by a remark of Prof. Huxley's in his essay "On the Physical Basis of Life," viz.: "And if so, it must be true in the same sense and to the same extent that the thoughts to which I am now giving utterance and your thoughts regarding them are the expression of molecular changes in that matter of life which is the source of our other vital phenomena" (*Fortnightly Review*, 1868).

It becomes evident in view of this that the phenomena of thought would be enormously influenced by the changes or permutations of which the molecules of matter were capable. Under the old theory of perfectly rigid molecules, it would seem difficult to conceive permutations enough to act as an accompanying physical basis to the phenomena of thought, for according to this theory, the mere motion or change of place of the molecules among each other would be the sole permutations of which they could be capable. But the modern theory of vortex-molecules shows molecules to be elastic bodies, which are consequently "capable of infinite changes of form"—as the late Prof. Clerk Maxwell remarks [*Encyc. Brit.* 1875, Article "Atom"]. It would therefore follow that according to the modern theory, the permutations of the physical accompaniment of thought would be absolutely infinite, in analogy with the infinite variety and range of thought itself. Possibly this may be a point of interest, if indeed it has not already been reflected on by others.

London

S. TOLVER PRESTON

A Speculation Regarding the Senses

ON examining the modes of action of the senses we find a series of advances in refinement. Beginning with *touch*, we find it has primarily to do with *solids* which come into direct contact with the organ. In *taste* a *liquid* medium is necessary. In *smell* we have minute particles carried by a *gas*. In *hearing* we have *vibrations* (longitudinal) in a *gas*. In *sight*, finally, we find transverse vibrations transmitted by a finer medium, the *ether*.

Now, whatever views may be taken of the doctrine of evolution, there can be no doubt of the progress of the human race in what we may generally here term *power*. And it is interesting to look into the future and inquire whether future developments of the relations between the *ego* and the *non-ego* may not, in time, take such forms as will be equivalent to the acquisition of new senses.

Guided by the gradation above referred to, I would throw out the suggestion that the molecular vibrations in the brain accompanying thought, may affect a surrounding medium, and through that, other brains at a distance, awaking in these corresponding vibrations and thoughts. The medium might be supposed, perhaps, one of different nature from that in which light-vibrations occur, or (not to multiply ethers) the same as the so-called luminiferous ether; and in the latter case we might suppose the vibrations such as not to be appreciated through any of the present senses of ordinary persons.

A person of high refinement and delicate organisation has a wonderfully exalted power (as compared, say, with a country bumpkin) of interpreting the *tout ensemble* of external appearance and bodily motions of another person in his presence, thereby perceiving at a glance much of the thought of that other, as it arises. But the kind of action I have referred to is of a still more delicate kind, and may be supposed to obtain when the eyes, and perhaps other avenues of sense, are closed. It might be termed a kind of *induction of thought*.

This speculation is not, I think, without some encouragement in actual fact. It is a familiar experience that two persons who are together will discover themselves to have been thinking of the same thing at the same moment; and this without any apparent cause in what one *sees* in the other, or in association of ideas in conversation. The ascertained facts of *clairvoyance* and *mesmerism*, however, are what I have more specially in view, and the light in which I would place them is that of a natural development of human faculty, at present appearing only sporadically and in few persons, but destined, perhaps,

* The molecules of matter, according to this theory, though indestructible (like the molecules of the ancients), are nevertheless *elastic*, or capable of distortion or changes of form (much in analogy with larger scale elastic solids), the molecule always tending to recover its natural symmetrical shape when released from constraint. These changes of form may of course be conceived infinite in variety, without the total amount of distortion itself being at any time great. This *elasticity* possessed by molecules is sufficiently proved by the vibrations of varied periods which the spectroscope shows them to be capable of executing.

by-and-by to become a universal possession in more or less degree.

It may require some peculiar state of mental calm or abstraction for this reading of the thoughts of another (apart from external expressions appreciated by the other senses) to become practicable, just as, in order to perceive distinctly the over-tones of a musical sound, it may be necessary to quench the fundamental tone.

As to the modification in the human body, supposing the sense in question to become general, this might be of a very minute character, constituting, not in the ordinary view, yet in a quite correct one, a distinct *organ*.

With regard to the influence of distance on the supposed sense, little, of course, can be said; but it is perhaps noteworthy that corresponding to the gradation referred to at the outset there is a general gradation in the distance at which the sense-exciting cause is capable of operating; from the direct contact of touch, to the action of light at the distance of a remote fixed star.

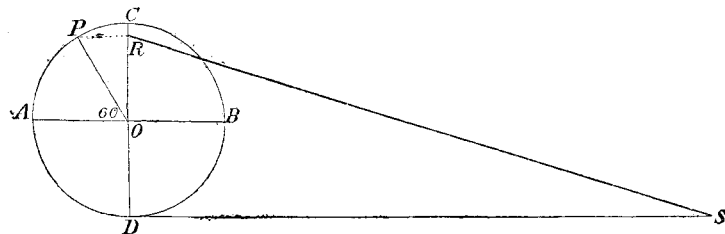
M.

The Circumference of the Circle

To some readers of NATURE the following construction will perhaps be of interest:—

Take AOB , DOC two diameters of a circle at right angles to one another.

Make the length of the tangent DS equal to three diameters of the circle $ADBC$, then make the angle $AOP = 60^\circ$, and



draw PR at a right angle to DC . Connecting the points S and R you will find the length RS very nearly equal to the circumference of the circle.

This will be clear from the following proof:—

From the triangle DRS we have—

$$RS = \sqrt{DR^2 + DS^2}.$$

But taking the diameter $DC = 1$ the length DS is $= 3$, whereas $DR = OD + OP \cos 30^\circ = \frac{1}{2} + \frac{1}{2} \cos 30^\circ = 0.9330127$. Therefore—

$$\begin{aligned} DR^2 &= 0.9330127^2 = 0.8705127 \text{ and} \\ DS^2 &= 3^2 = 9.0000000 \end{aligned}$$

$$DR^2 + DS^2 = 9.8705127$$

$RS = \sqrt{DR^2 + DS^2} = 3.141738$, whereas the exact value of π is 3.141592 , giving a difference of 0.000146 , or 0.0046 per cent.

This approximation is, of course, more than sufficient for practical purposes. Although this method has been found by me quite independently, yet I shall not be surprised to hear of its having been proposed before by others, for it is almost too simple not to have occurred to somebody else as well as to me.

Prague, Spálená ulice, 2 nově, January 11 L. HAJNÍŠ

Sun-Spots, &c.

I READ with interest the letter of Mr. Bedford's in NATURE, vol. xxi. p. 276, on "Sun-Spots." Perhaps the following may interest Mr. Bedford, and as I have not seen this noticed before by students of the solar orb, it may interest others besides Mr. Bedford.

Prof. Sayce, in his Lectures, says: "The Accadians had anticipated our almanack-makers in discovering a connection between the weather and the changes of the moon; indeed all kinds of astronomical phenomena were supposed to have an influence upon the clouds; and in anticipation, as it were, of Dr. Hunter, the same weather was expected to recur after a cycle of twelve solar years." . . . Even the appearance of the sun was not allowed to go unnoticed, and in one place we are told that on the 1st of Nisan it was "bright yellow," and in

another that it was "spotted." Who, says the professor, "would have thought of looking for a notice of sun-spots in the clay tablets of ancient Babylonia?" Lectures, pp. 53-54. See also the "Astronomy and Astrology of the Babylonians," by the same, in the *Transactions of the Society of Biblical Archaeology*, vol. iii. pp. 145, 339.

EDWARD PARFITT

Devon and Exeter Institution, Exeter, January 27

Intellect in Brutes

IT might prove interesting to some of your readers to put the following incidents on record relative to intellect in brutes:— Some time ago I kept in town a bitch and three of its puppies; the former had a strong pair of lungs and a weakness for letting the passers-by know it; when the latter became of age they exhibited all the hereditary peculiarities of the mother, and when the four animals joined in chorus, which was their favourite amusement at night, the result was anything but agreeable. Some of my friends hinted to me that if that state of things continued I should probably be indicted for causing a nuisance, and I therefore determined to explain to my four animals that they really mustn't bark. One night I remained late in town, and having provided myself with a stick, I waited till I heard one of them bark, and I immediately afterwards went out and chastised him, or rather the one I thought had made the noise. I was, however, soon met by a difficulty; although I could recognise the bark of the old one, I could not discriminate well

between those of the puppies; and whilst the old one was silenced after a few chastisements, the puppies were not; probably in mistake I had thrashed the wrong puppy. I therefore hit upon the plan of making the whole four responsible for each other, and as soon as I heard any one of them bark I applied my stick freely to the whole four, the one after the other. When this had been done two or three times I heard one of the puppies bark, and the next moment it gave a pitiful squeal; the mother had it by the neck. I went out and patted her, thus explaining that she had done well. She wagged her tail, as much as to say she under-

stood me perfectly, and the dogs never barked again except upon the most provoking occasions.

Some other instances which I observed lately might be mentioned as tending to show that animals of a much lower class exhibit reasoning faculties. I had occasion lately to keep some leeches and water-beetles; they were put into round open glass vessels, about six inches high and about two-thirds full of water. A medical leech which was put into one of these vessels got out, and within an hour afterwards it was found on the table and replaced in the water. Now although the vessel was left uncovered as before, this leech never again tried to get out. A horse-leech and two water-beetles, treated in the same way did the same thing once, and once only; each preferred the water to the dry table, and on being replaced they never tried to get out again; *ergo*, they had been taught by experience. Is this not a high order of intelligence? How many examples have we of the genus *homo* where so much intelligence is not exhibited?

Manchester, January 17

W. THOMSON

SEEING a letter in NATURE, vol. xxi. p. 276, with the heading of a "clever spider," puts me in mind of a circumstance that came under my own observation near Tremadoc, in North Wales, many years ago. I sat down on a bank about four o'clock in the afternoon after a long day, when I presently saw I was close to one of the common garden spiders of rather large size, with its pretty spreading net-like web about a yard from the ground; so, for want of something to do, I alarmed the spider to discover where his *den* was, when off he trotted about the distance of a foot to a couple of leaves nicely tied together, where he stayed perhaps ten minutes; I then saw a beetle of rather large size walking at my feet—one of those slow moving dull black ones—I am not coleopterist enough to know its name; I picked it up and put it in the web at a place I thought sufficiently strong to hold it, when out rushed the spider in his boldest manner. But when he saw who his visitor was, what an alteration in his manner! He drew back, and rapidly separated the cords, when down dropped the beetle on a single line, rather quickly, to within about 4 inches of the ground, so that he was suspended on a line about $2\frac{1}{2}$ feet long. The spider then trotted back to his den. The beetle was now struggling in its slow,